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CONSOLIDATED VULTEE

DIVISION San Diego
MODEL XFY-1

REPORT CVAL 107
DATE 11-1-52

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TITLE

Report CVAL 107

LOW-SPEED WIND TUNNEL TESTS OF A .15 SCALE POWERED MODEL OF THE XFY-1 AIRPLANE WITH 57° WING LEADING EDGE SWEEPBACK

Tested 2-20-52 to 3-12-52, 3-27-52 to 4-5-52,
4-30-52 to 5-10-52 & 6-4-52 to 7-2-52.

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REFERENCE CVAL 96

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2	1-30-53	CWP	Added page 6a	6a

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INTRODUCTION

This report presents data from low-speed wind tunnel tests of a powered .15 scale model of the Convair XFY-1 airplane. The tests were conducted in the 8- by 12- foot test section of the Convair Wind Tunnel in four periods during 1952. They were as follows: February 20 to March 12, March 27 to April 5, April 30 to May 10, and June 4 to July 2. These tests were authorized under Navy Contract NOa(s) 51-936 and were accomplished in a total of 444.0 wind tunnel hours.

The purpose of these tests was to obtain basic stability and control data for the XFY-1 model during normal flight, transitional flight, and hovering flight conditions. Hovering flight was investigated both in free air and in close proximity to the ground. Runs were made at dynamic pressures of 0 to 103.5 lbs/sq.ft. Normal flight tests were run at Reynolds numbers from 2.18×10^6 to 4.45×10^6. Transitional flight tests were run at Reynolds numbers from 4.37×10^5 to 2.18×10^6. The basic configuration consisted of the complete model with wing, body, vertical tails, propellers, gun pods, oleos, and oil cooler. In addition, a different vertical tail with a 50° swept leading edge was tested. Normal flight runs were made with the pilot's canopy closed, see photo no. 6. Transitional and hovering flight runs were made with the pilot's canopy open, see photo no. 9. A threeview sketch of the complete model is shown on page 7. The model was in good condition during the tests.

MODEL AND METHODS

The model was supported by a special "L" shaped strut and sting which was entirely shielded, see photo no. 12. Pitch runs were made by yawing the balance system after the model was rolled 90° about its longitudinal axis to the position shown in photo nos. 9 and 10. Yaw runs were accomplished by yawing the balance system with the wings level, see photo no. 6. Six component force data were recorded for all pitch and yaw runs. The support strut was designed with an adjustable yoke at the knee so that the model could be pitched at constant angles of yaw and yawed at constant angles of pitch. This was accomplished thru a series of holes on the vertical support strut which allowed adjustment of the horizontal sting to various angles, see sketch page 11. The model could also be set at various fixed roll angles by rotating the model about its longitudinal axis, see sketch page 22.

For pitch tests with the model at some fixed angle of yaw (other than zero) the geometry of the support system caused the model to pitch about a vertical axis and not about the lateral Y-Y axis of the model, see sketch page 22. Similarly when the model was rolled to some fixed roll angle it did not pitch about its lateral Y-Y axis. For these reasons the defined geometric angles of attack, yaw, and roll did not always coincide with the angles as set in the

MODEL AND METHODS (Cont'd)

tunnel. Wind tunnel reference angles are defined in sketch on page 22. Geometric reference angles as defined by NACA in NACA TR-474 are shown in sketch on page 23. The relationships between wind tunnel reference angles and geometric reference angles for pitch tests have been evaluated and are presented in Figures A and B.

For yaw tests, the relationships between wind tunnel reference angles and geometric reference angles as defined by NACA were also evaluated and the tunnel reference angles were found to be the same as the geometric reference angles.

During transition and hovering runs the large change in blocking area over the angle of pitch or yaw range and the large blocking area involved at high angles of attack or yaw necessitated a special investigation of blocking effects for this particular installation. A pressure survey was made in the test section of the tunnel with the model set at various angles of attack or yaw. From this survey a calibration was made for correcting the dynamic pressure as set by the tunnel operator with each change in model angle.

The data obtained from the pressure survey and an analysis of these data including the blocking corrections for this report are presented in CVAC Aero Memo A-5-35. A subsequent study and investigation of blocking corrections for the CVAL subsonic wind tunnel has been made and is presented in CVAL 107, Addendum I, to be published under separate cover.

Data were recorded for various ranges of angles depending on the flight condition listed below.

Normal Flight	Pitch -2° to 28° Yaw -2° to 20°
Transitional Flight	Pitch 10° to 90°
Hovering Flight (with crosswind)	
Crosswind tending to increase angle of attack	V_z/V_{s_∞} = 0 to .376
Crosswind tending to increase angle of yaw	V_y/V_{s_∞} = 0 to .376

Hovering tests were made by setting the model at various tilt angles, see photo nos. 19 and 20, sketches pages 24 and 25, and varying the tunnel speed

MODEL AND METHODS (Cont'd)

to simulate a crosswind. Several points were taken at each crosswind setting to investigate the aerodynamic spread of force and moment components. Model thrust was held constant during all hovering runs.

Model thrust was developed by a controllable speed electric motor driving scale size contra-rotating propellers. For transitional and hovering flight tests, the front propeller blade angle was set for zero model torque for condition of static thrust. The motor-propeller combination was calibrated for constant T_c' settings as shown in figures C and D. During normal and transitional flight, thrust was set and held constant by varying the model motor RPM with each change in angle of attack or yaw. Because the propeller calibration for normal flight runs was made with wing and tails intact on the model for both power off and power on runs it is believed that the RPM settings are slightly higher than actually required. Propeller calibration for transitional flight runs was made with wing and tails removed from the model, see photo nos. 1-4. The range of T_c' settings was determined from full scale performance data and was chosen as representative of the flight range under investigation. During hovering tests model thrust was held constant by varying the model motor RPM with each change in tunnel speed, see figure E.

During pitch runs in transitional flight at low tunnel speeds ($q = 1$ to 5), a coarse mesh turbulence net was placed at the downstream end of the test section to dissipate the model propeller slipstream, see photo no. 1. The net was removed for other runs at higher tunnel speeds where the contribution of model slipstream to the total stream flow was relatively small.

Static pressures were measured at several positions around the prop spinner with the propellers removed, see sketch page 13 for description of static pressure rake and pressure tube locations. The pressure rake was fixed in the tunnel in a vertical position and the model rotated around its longitudinal axis to obtain the various rake positions around the spinner.

RESULTS

All force data are presented in coefficient form in figures 1.01 to 1.18, 2.01 to 2.70, and 3.01 to 3.83. Normal flight force data are presented on figures 1.01-1.18, transitional flight force data on figures 2.01-2.70, and hovering flight force data on figures 3.01-3.83. Prop spinner pressure data are presented in coefficient form on page 97, and are based on free stream dynamic pressure. Moment data were transferred to a center of moments located at 14% of the mean aerodynamic chord and .698 inches model scale above the thrust line, see sketch page 8. Pictorial tuft data showing the vertical tail flow pattern during transitional flight pitch runs for 0° and -5° yaw and with three power settings are presented in photo nos. 41 to 52. Tuft pictures showing the wing flow pattern during hovering flight are presented in photo no. 53.

RESULTS (Cont'd)

Additional tuft photos showing the vertical tail flow pattern during transitional flight at other power settings are on file at the Convair Wind Tunnel.

Normal Flight Data

Only the primary components of force data for the normal flight runs are presented in figures 1.01-1.18. These data are presented in coefficient form and are all referred to stability axes. Stability axes are defined as axes which yaw with the model but do not pitch, see sketch page 26 for definition of stability axis notation. Force coefficients are based on wing area and pitching moment coefficient on wing area and mean aerodynamic chord. Rolling and yawing moment coefficients are based on wing area and span. Wall corrections based on unswept wing theory were applied to angle of attack and drag data. Aerodynamic tares to correct for the interference effect of the support windshield were applied to all normal flight data except figure 1.11, page 113. Free stream dynamic pressure was corrected for blocking effects based on the frontal area of the model.

Transitional Flight Data

In general only the primary components of force data for transitional flight are presented on figures 2.01-2.70. Data which pertain mainly to longitudinal stability and control are referred to stability axes on figures 2.01-2.10. Data which pertain mainly to lateral and or directional stability and control are referred to body axes on figures 2.11-2.70. The lateral components of transitional flight data, particularly rolling moment, were in general eratic and difficult to repeat for angles of attack from 50° to 90°. Poor repeatability of points was particularly experienced for runs made at dynamic pressures of 5 and 8 lb/ft^2. Body axes are defined as three mutually perpendicular axes, through the center of moments, of which the longitudinal and lateral axes are in a plane parallel to the wing reference plane and the longitudinal axis is also in the plane of symmetry. The NACA sign convention for body axes is used where normal force is positive down and axial force positive forward, see sketch page 27 for definition of body axis notation. Force and moment coefficients are based on the same terms as used for normal flight data. Wall corrections were not known for the transitional flight condition and were not applied. Aerodynamic tares to correct for the interference effect of the support windshield were applied to all transitional flight data. Blocking corrections for the determination of free stream dynamic pressure were determined experimentally by a pressure survey made with the model in the tunnel and were applied with each change in model angle.

RESULTS (Cont'd)

Hovering Flight Data

In general only the primary components of force data for hovering flight are presented in figures 3.01-3.83. All moment coefficients presented for hovering flight are referred to body axes. Force coefficients are referred in part to body axes and in part to wind axes. Force coefficients of data taken for determination of lateral control effectiveness and trim conditions with the model set at various rolled atitudes are referred to wind axes. All other force coefficients are referred to body axes. Wind axes are defined as always parallel and perpendicular to the tunnel wind direction, see sketch page 24. Positive directions of forces for wind axes are the same as for stability axes. NACA sign convention is used for body axes, see sketch page 27.

All hovering data are plotted as a function of the ratio of crosswind velocity to the theoretical slipstream velocity of the propeller. The theo theoretical dynamic pressure of the propeller slipstream at a large distance behind the propeller disc was used as a basis for all force and moment coefficients. This was considered to be model thrust divided by propeller disc area. In addition force coefficients are based on model wing area and pitching moment coefficient on wing area and mean aerodynamic chord. Rolling and yawing moment coefficients are based on wing area and span. No wall corrections were applied to hovering data. Aerodynamic tares for correction of the interference effect of the support windshield were applied to all hovering flight data taken in the free air condition. No aerodynamic tares were applied to hovering data taken with the ground board installed because the model support was behind the ground board for most conditions, see photo no. 17.

Blocking corrections for determination of crosswind dynamic pressure were determined and applied in the same manner as for transitional flight data.

Aerodynamic Tares

Extensive tare tests were made during this testing program to evaluate the interference effects of the support windshield on the forces and moments measured on the model. The general procedure for tare evaluation was to simulate a portion of the upper or lower windshield on top of the main support windshield and to test this configuration at the same tunnel

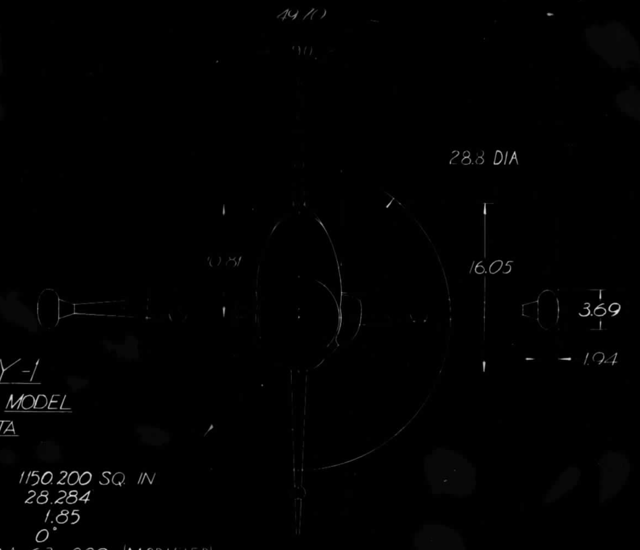
RESULTS (Cont'd)

speed and model power condition as was the configuration for which the tare evaluation was sought, see sketch page 14, photo nos. 39 and 40. The tare run was then compared with a base run made with the same model configuration, tunnel speed and power conditions but without the added portion of the support windshield. The portion of the support windshield which was added to the main windshield was designed to simulate that portion of the main windshield which affected the model for a given set of model conditions. Although this tare procedure did not exactly simulate the flow over the support windshield induced by the model for normal runs, it was assumed to be a reasonable approximation for tare evaluation of this model.

Tares were run in this manner for normal flight, transitional flight, and for hovering flight in free air. For normal flight a portion of the tares were interpolated for different power settings.

In general the tares for transitional and hovering flight were large and varied considerably with model angle. Tares for normal flight were comparatively small but varied considerably with model angle.

The aerodynamic tares discussed above and the tare runs from which they were computed are not presented in this report but are on file at the Convair Wind Tunnel.



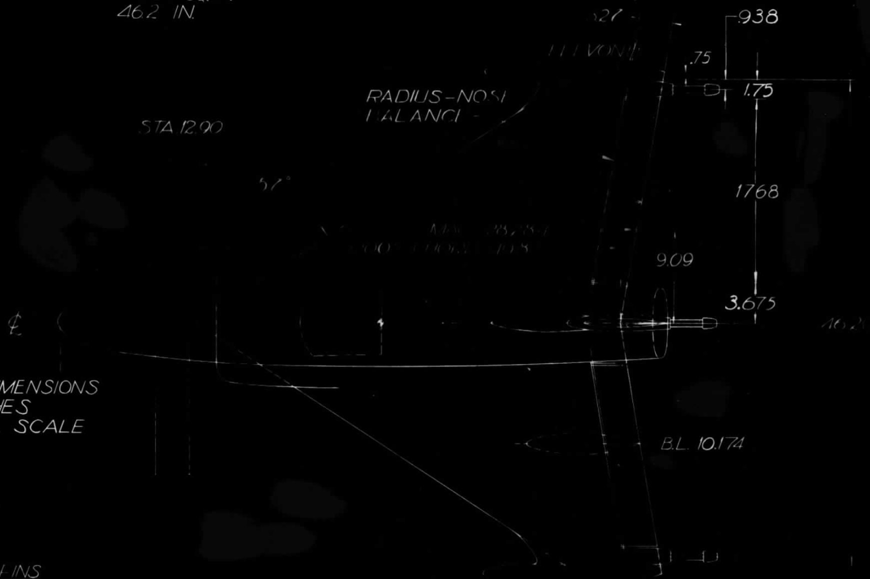
MODEL XFY-1

15 SCALE WIND TUNNEL MODEL

DIMENSIONAL DATA

WING

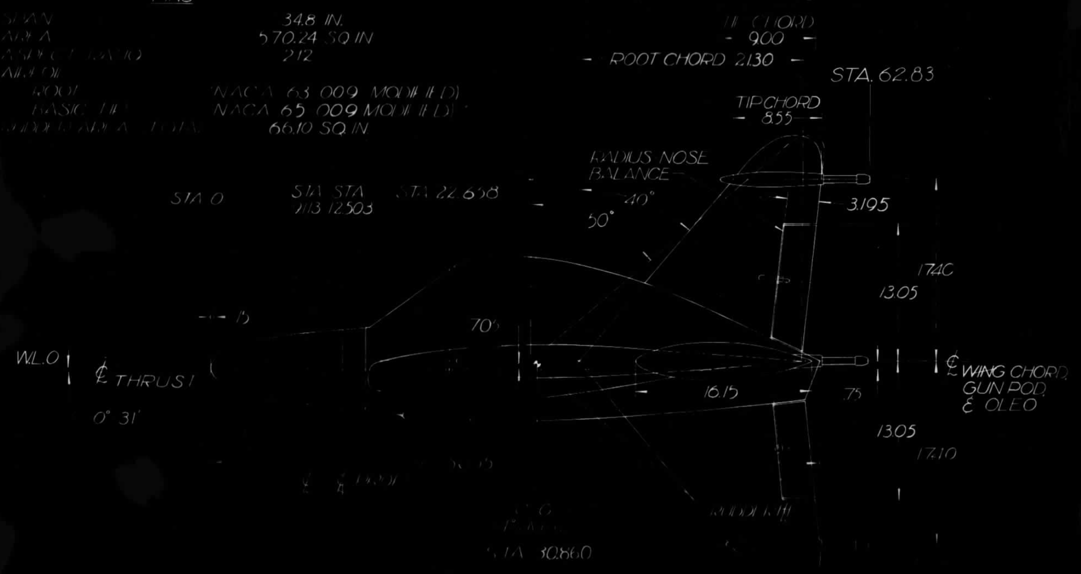
AREA	1150.200 SQ. IN
MAC	28.284
ASPECT RATIO	1.85
INCIDENCE	0°
AIRFOIL	NACA 63-009 (MODIFIED)
DIHEDRAL	0°
ELEVON AREA, TOTAL	166.64 SQ. IN.
SPAN	46.2 IN.



NOTE: ALL DIMENSIONS
IN INCHES
MODEL SCALE

FINS

SPAN	34.8 IN.
AREA	570.24 SQ IN
ASPECT RATIO	2.12
AIRFOIL	
ROOT	NACA 63 009 MODIFIED)
BASIC TIP	NACA 65 009 MODIFIED)
RUDDER AREA, TOTAL	66.10 SQ. IN.



MODEL XFY-1
GENERAL ARRANGEMENT

[redacted]

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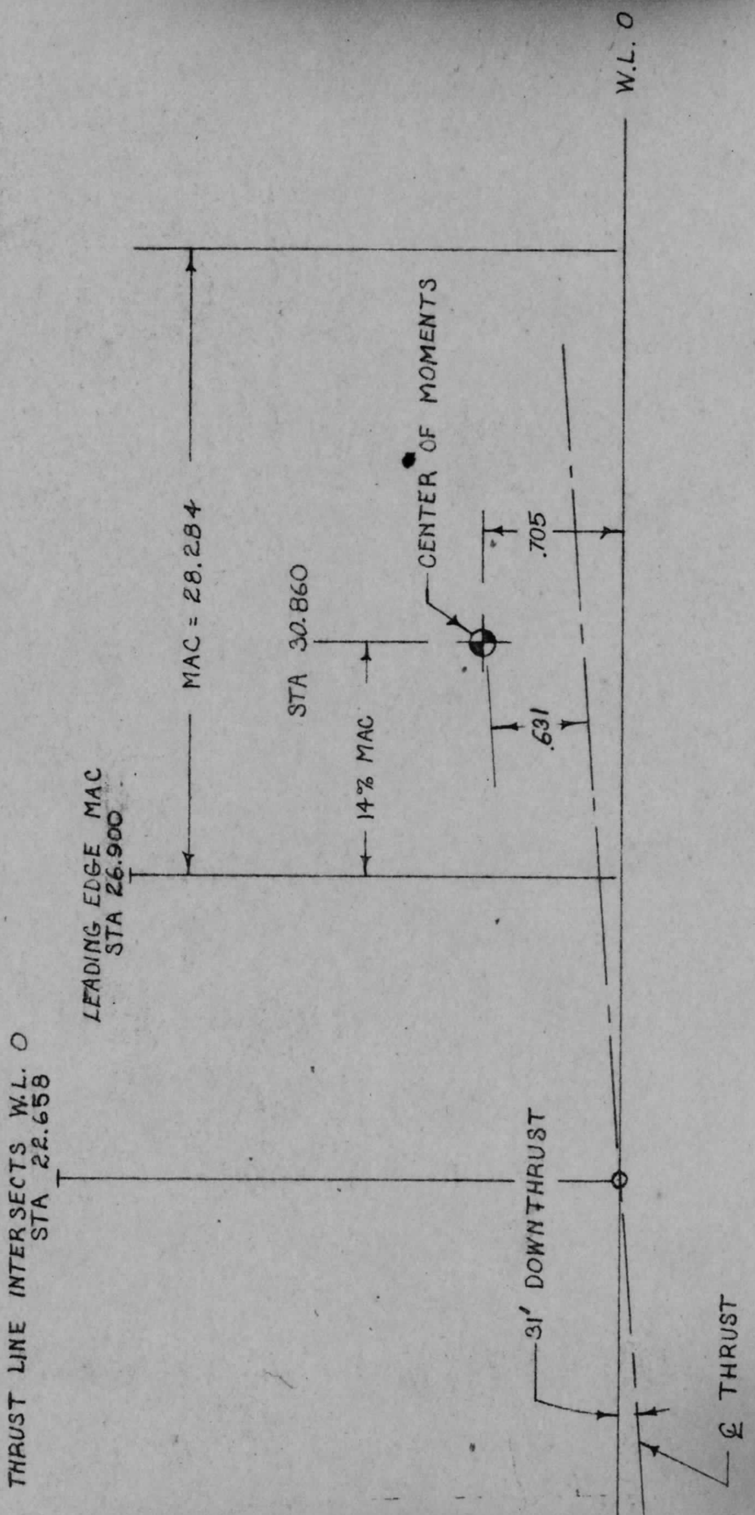

ALL DIMENSIONS INCHES MODEL SCALE

WING AREA = 7.988 FT^2
WING SPAN = 46.20 INCHES

MOMENT REFERENCE DIAGRAM

.15 SCALE XFY-1 CVAL 107A

SKETCH NOT TO SCALE

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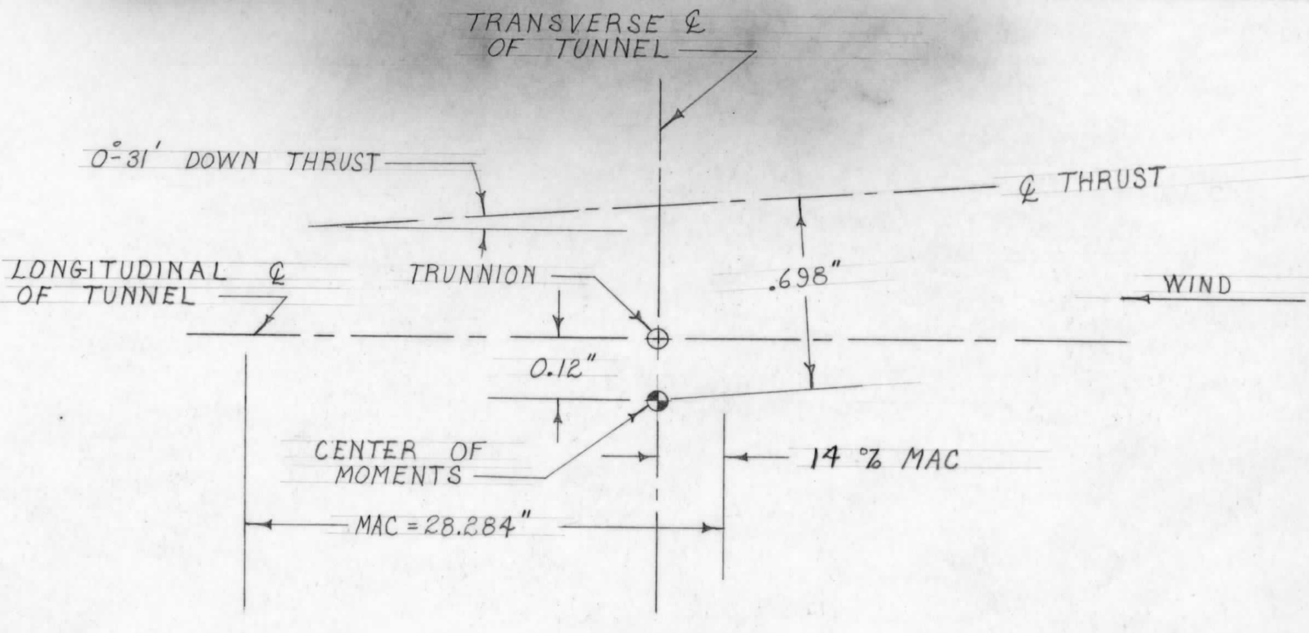
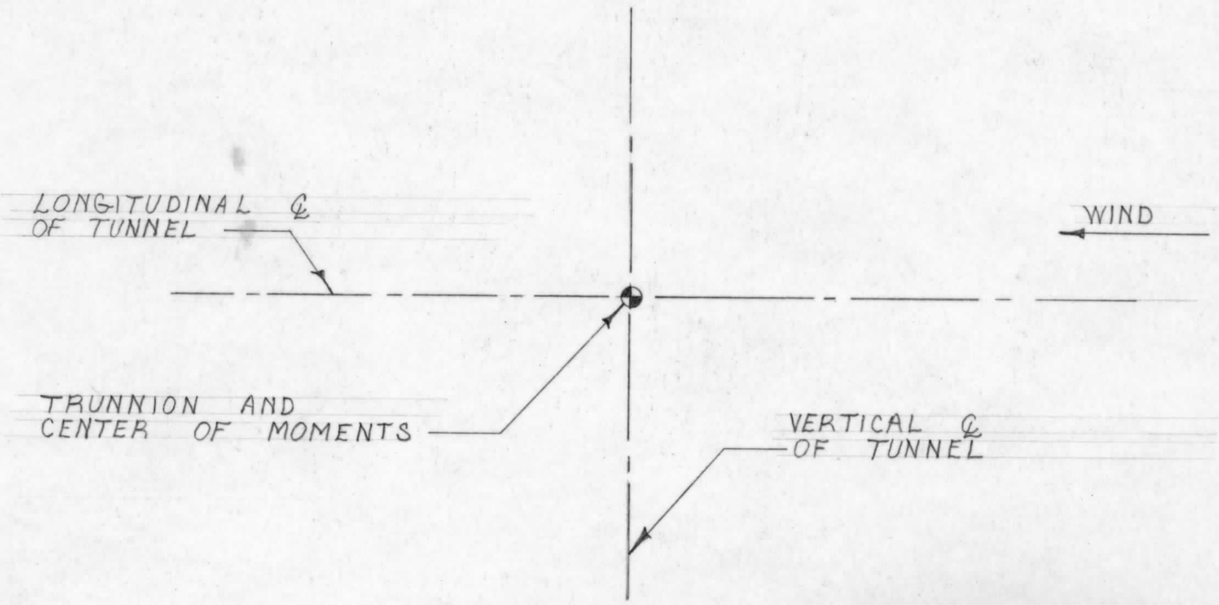


PLAN VIEW OF TUNNEL
SIDE VIEW OF MODEL



SIDE VIEW OF TUNNEL
PLAN VIEW OF MODEL

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MOMENT TRANSFER DIAGRAM

MODEL RIGGED FOR PITCH, $\alpha_t = \psi_t = \phi_t = 0^\circ$

RUNS 1-223*

*NOTE-
FOR RUNS 223-ON CENTER OF MOMENTS AND TRUNNION COINCIDED

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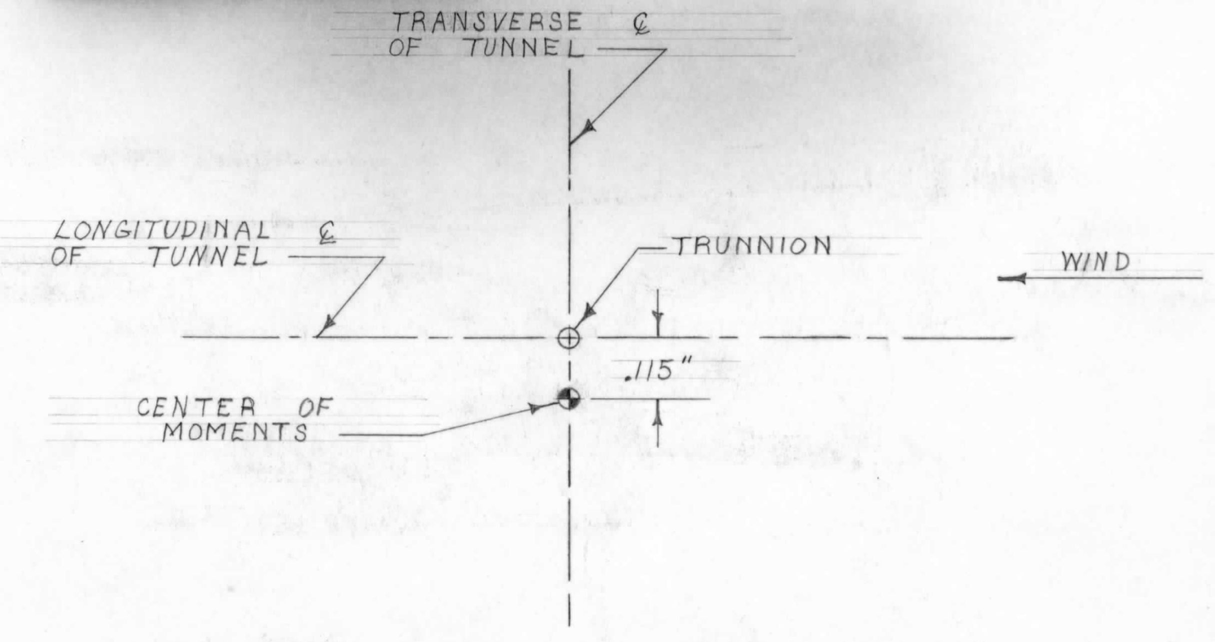
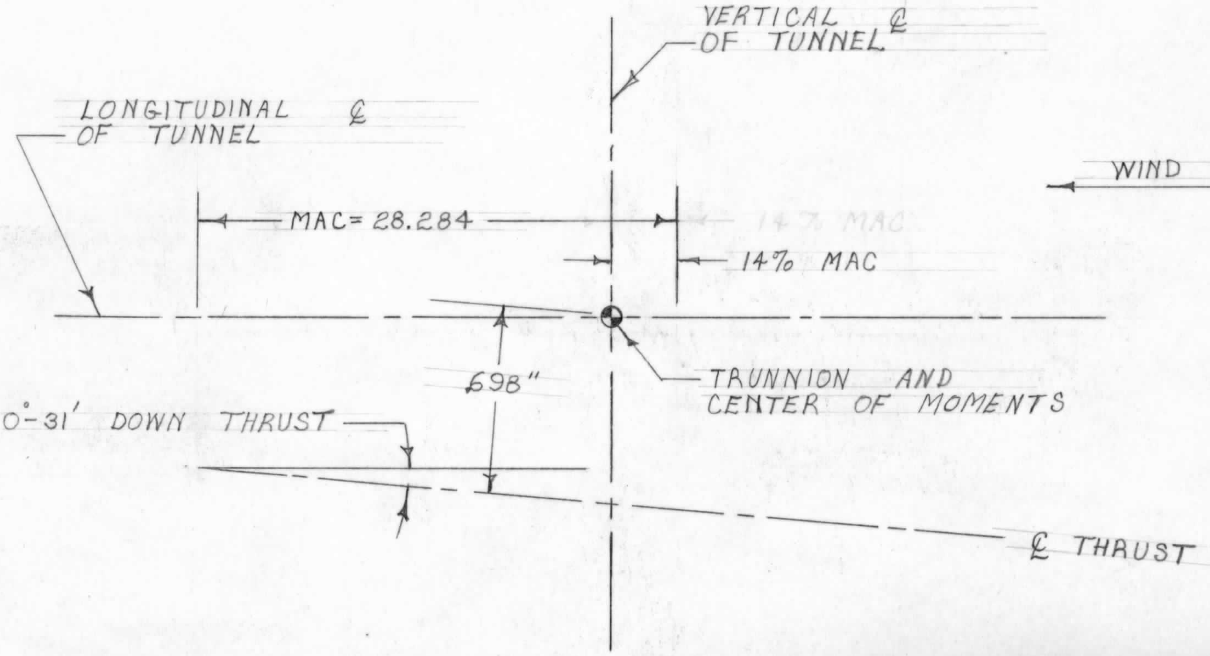


PLAN VIEW OF TUNNEL AND MODEL



SIDE VIEW OF TUNNEL AND MODEL

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MOMENT TRANSFER DIAGRAM

MODEL RIGGED FOR YAW, $\psi_t = \alpha_t = \phi_t = 0^\circ$

RUNS 1-223*

*NOTE –
FOR RUNS 223-ON CENTER OF MOMENTS AND TRUNNION COINCIDED

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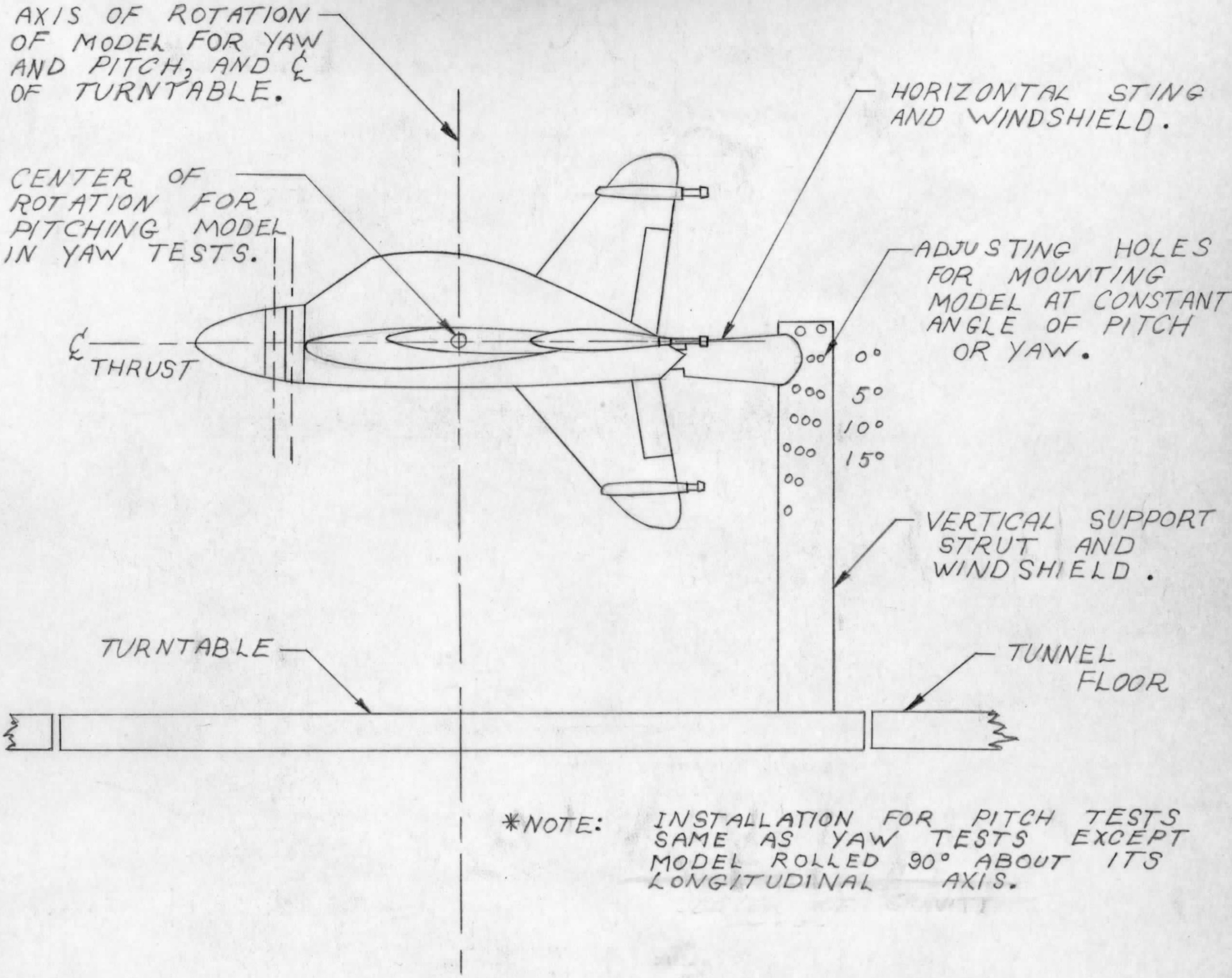
AXIS OF ROTATION OF MODEL FOR YAW AND PITCH, AND ℄ OF TURNTABLE.
HORIZONTAL STING AND WINDSHIELD.
CENTER OF ROTATION FOR PITCHING MODEL IN YAW TESTS.
ADJUSTING HOLES FOR MOUNTING MODEL AT CONSTANT ANGLE OF PITCH OR YAW.
℄ THRUST
0°
5°
10°
15°
VERTICAL SUPPORT STRUT AND WINDSHIELD.
TURNTABLE
TUNNEL FLOOR

*NOTE: INSTALLATION FOR PITCH TESTS SAME AS YAW TESTS EXCEPT MODEL ROLLED 90° ABOUT ITS LONGITUDINAL AXIS.

MODEL SUPPORT INSTALLATION FOR YAW TESTS*
.15 SCALE XFY-1

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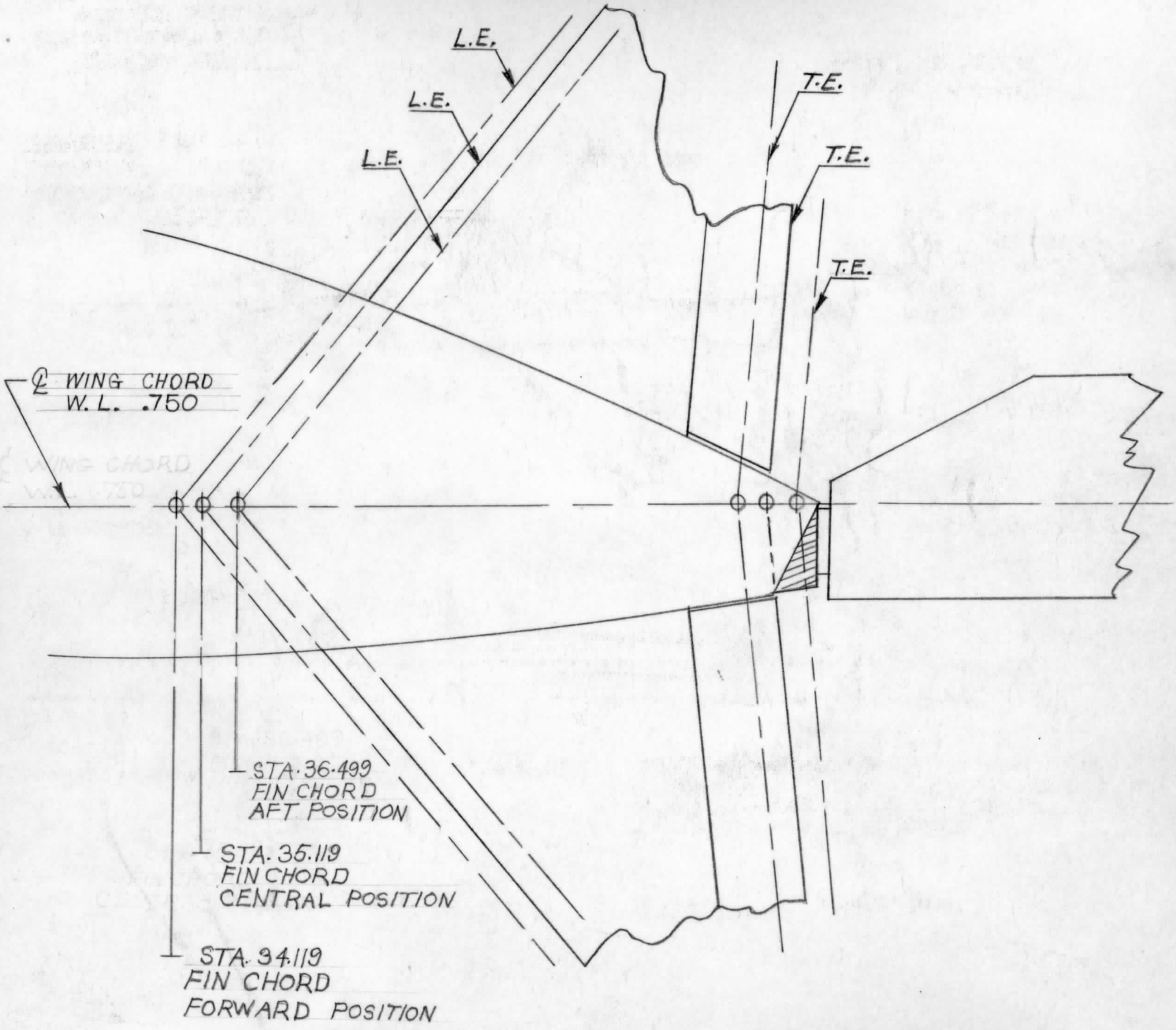

VERTICAL TAIL LOCATION
V_3, 40° BASIC FIN
.15 SCALE XFY-1

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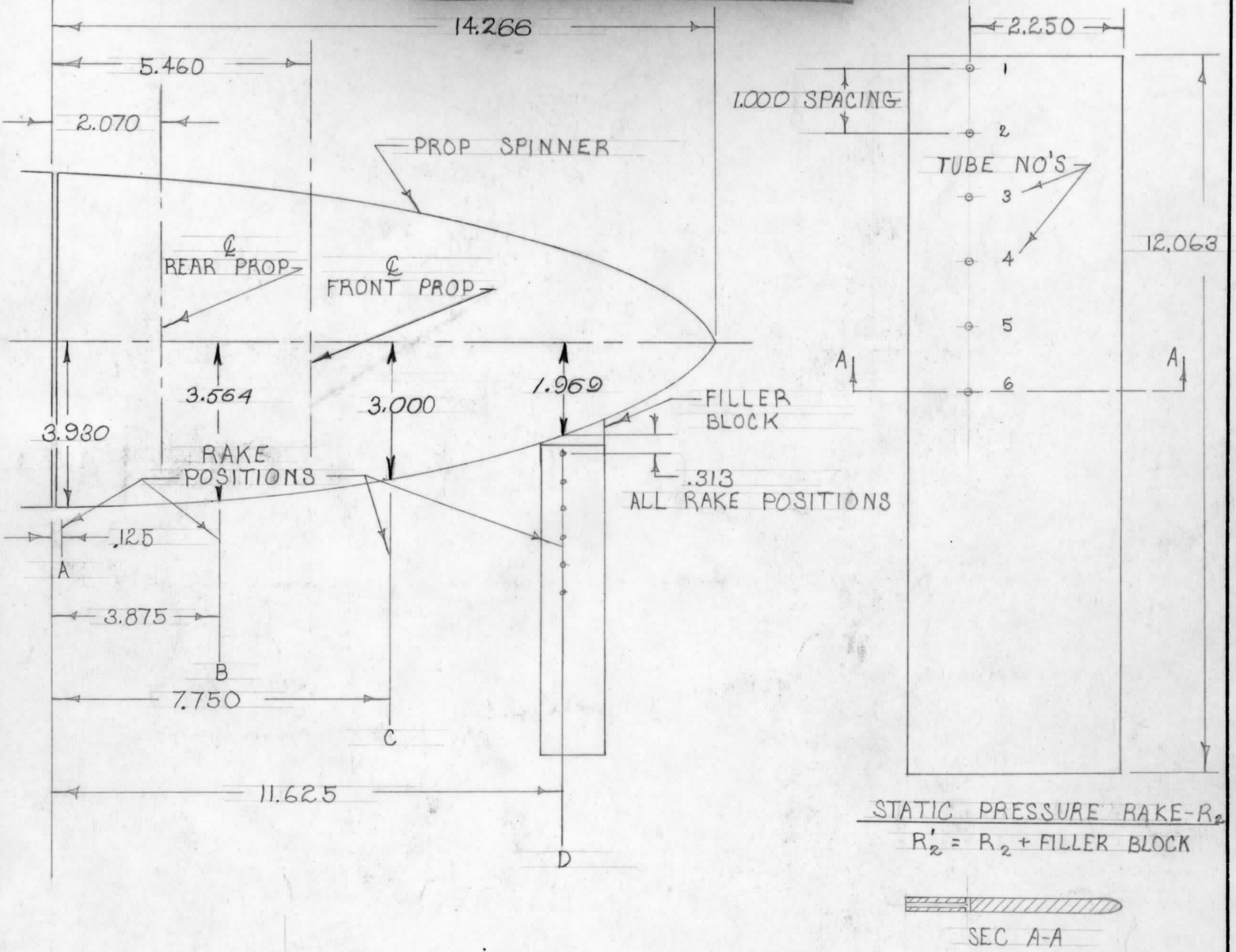
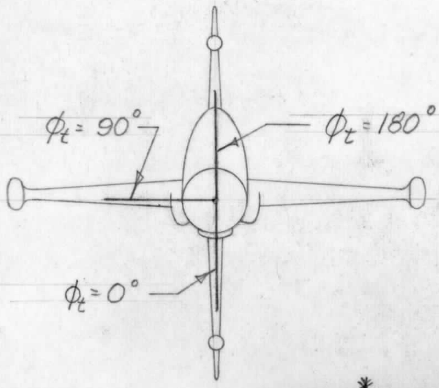


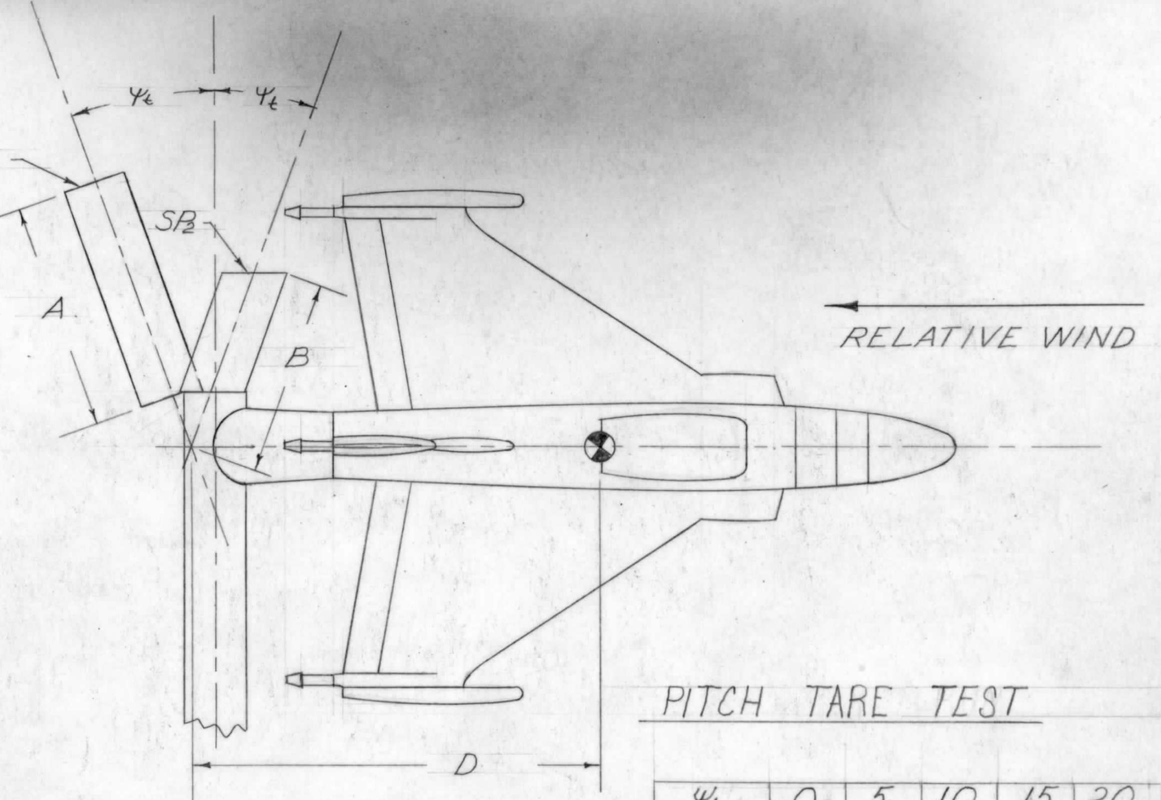


ALL DIMENSIONS IN INCHES MODEL SCALE

STATIC PRESSURE RAKE DETAILS FOR R_2 & R'_2, RUNS 728 - 739

RAKE ROTATION*

*NOTE:
MODEL WAS ROTATED
ABOUT RAKE FOR
ABOVE CONDITIONS, RAKE
HELD STATIONARY AT $\phi_t = 0°$

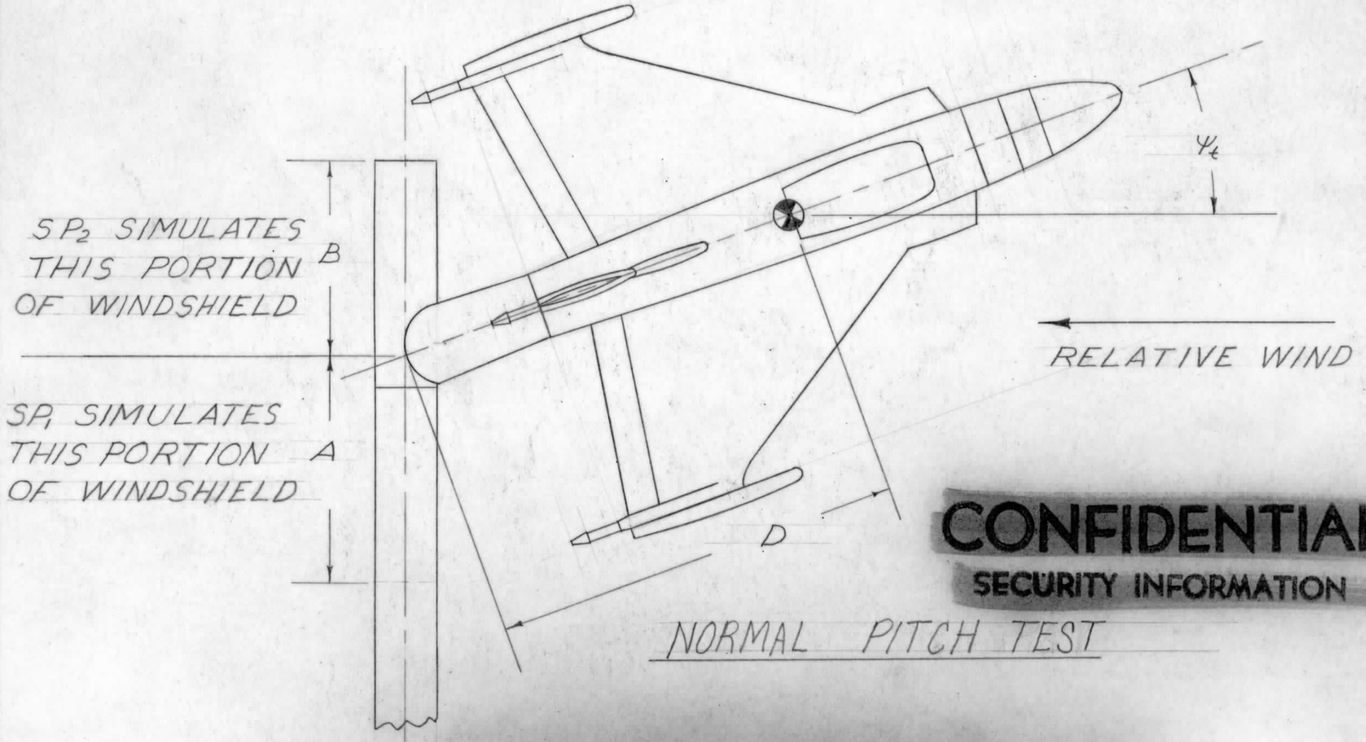


PITCH TARE TEST

ψ_t	0	5	10	15	20
UPPER	—	SP_2^5	SP_2^{10}	SP_2^{15}	SP_2^{20}
LOWER	SP_1^0	SP_1^5	SP_1^{10}	SP_1^{15}	SP_1^{20}

SUPERSCRIPT INDICATES ψ_t

NOTE:
FOR YAW TESTS MODEL IS ROLLED -90°


SP_2 SIMULATES THIS PORTION OF WINDSHIELD
B
SP_1 SIMULATES THIS PORTION OF WINDSHIELD
A
ψ_t
RELATIVE WIND
D

NORMAL PITCH TEST

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DETAILS OF SUPPORT WINDSHIELD ADDITIONS FOR AERODYNAMIC TARE TESTS, PITCH TESTS

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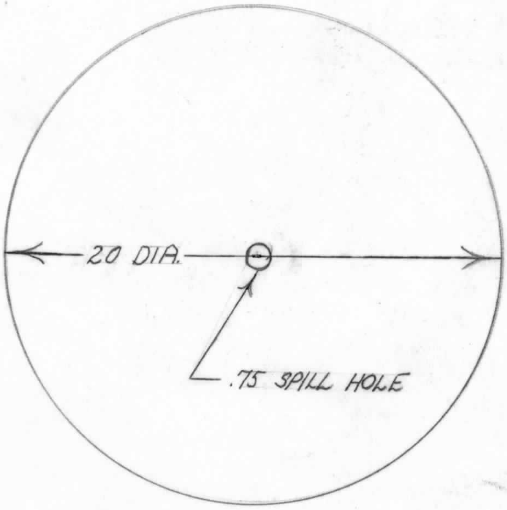

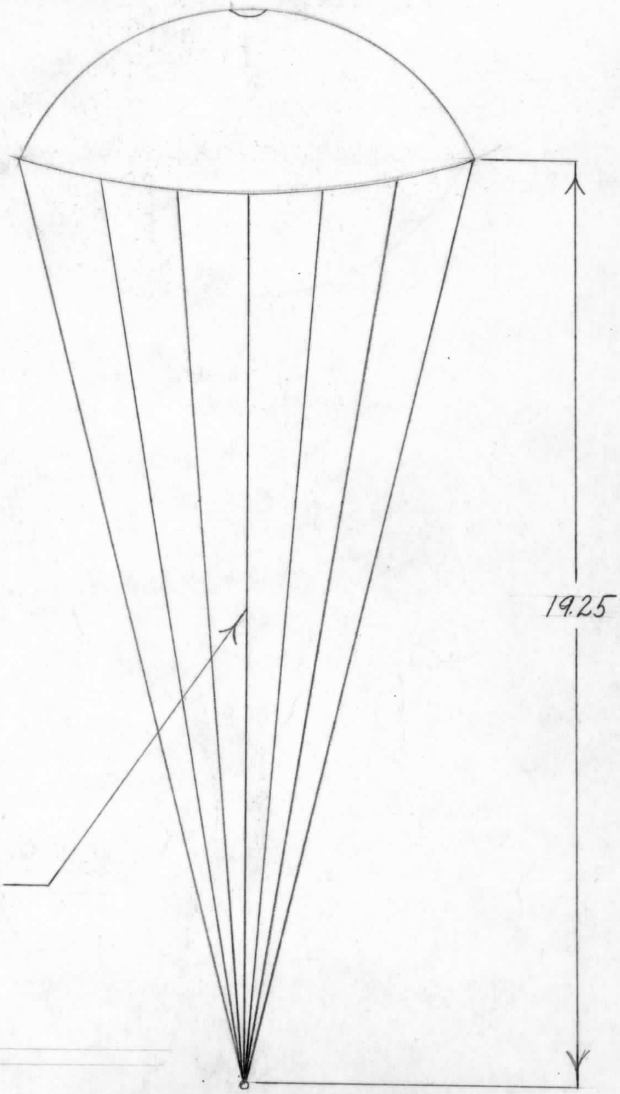

MATERIAL:
SHEER, LIGHTWEIGHT NYLON, ONE PIECE

DIMENSIONS INCHES MODEL SCALE

ANTI-ROLL PARACHUTE (Z_1)

(ATTACHED TO RIGHT-HAND WING TIP)

.15 SCALE XFY-1

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11-12-52-D.L

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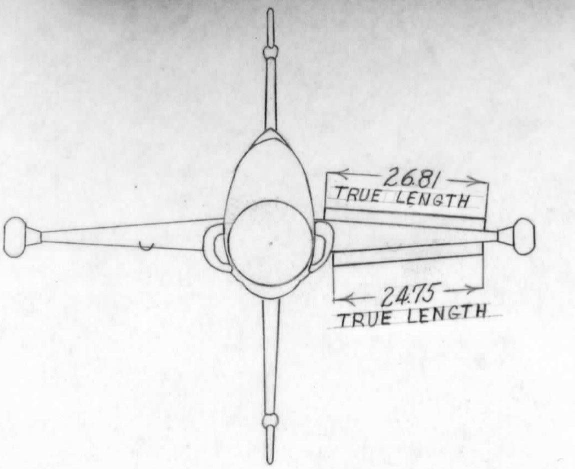
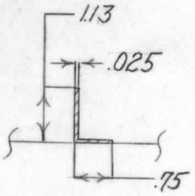
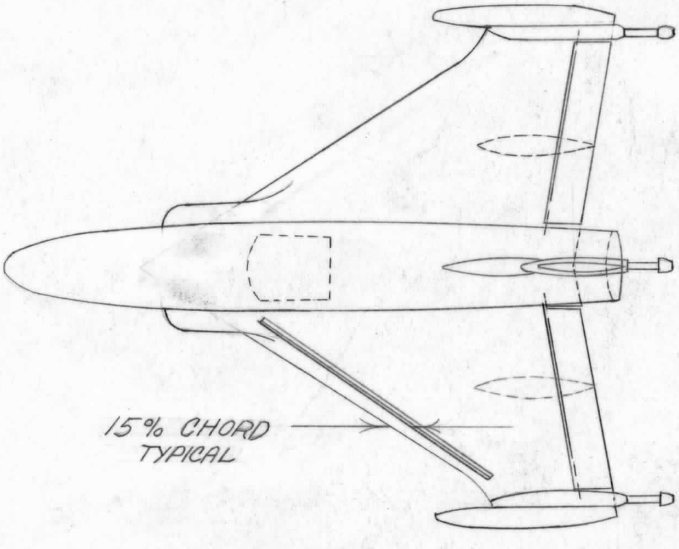




CROSS SECTION
1/4 SCALE



DIMENSIONS INCHES MODEL SCALE

CONFIGURATIONS:

Z_2 = TOP AND BOTTOM SPOILER, LEFT HAND LEADING EDGE

Z_3 = TOP SPOILER ONLY, LEFT HAND LEADING EDGE

LEADING EDGE SPOILERS, Z_2 & Z_3

.15 SCALE XFY-1

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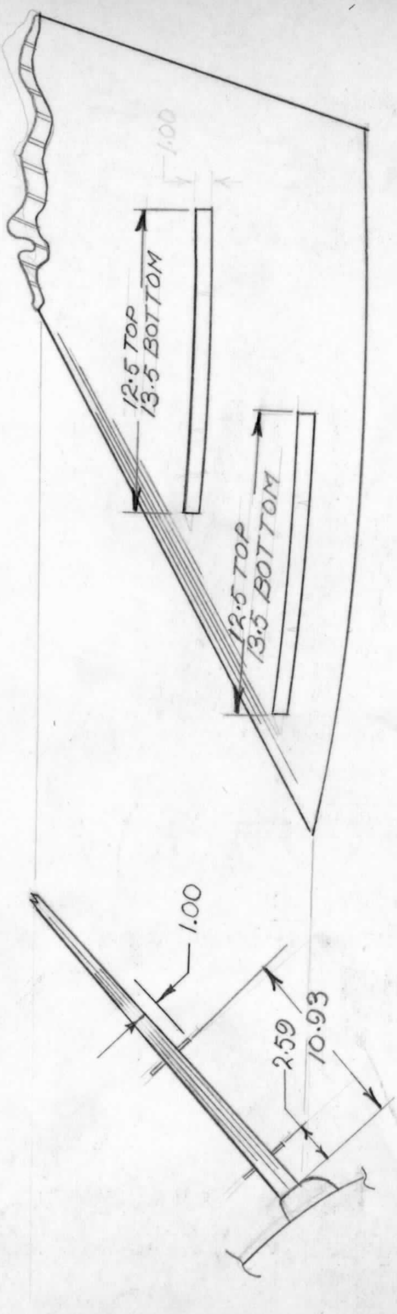
H.H.R. 11-13-52



(L.H. WING ONLY)

Z_4 WING DAMS

.15 SCALE XFY-1

DIMENSIONS INCHES MODEL SCALE

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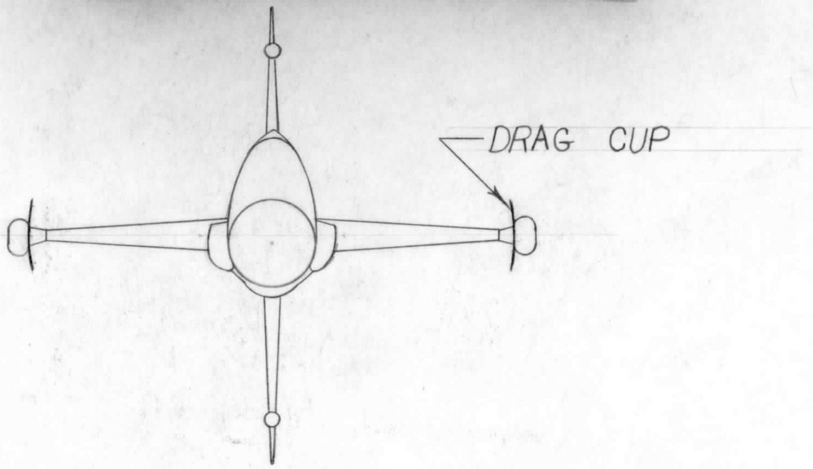

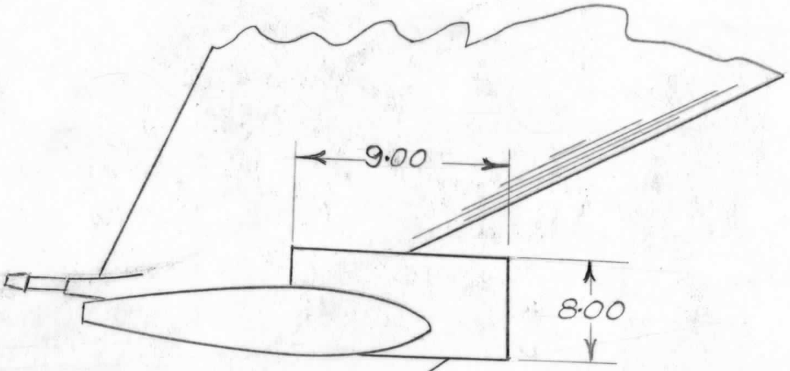

Z_5, Z_6 .040 24ST DURAL PLATES
ATTACHED TO MACHINE GUN PODS

CONFIGURATIONS:

Z_5, RIGHT-HAND WING TIP ONLY
Z_6, BOTH WING TIPS

DIMENSIONS INCHES MODEL SCALE

DRAG CUPS, Z_5 & Z_6

.15 SCALE XFY-1

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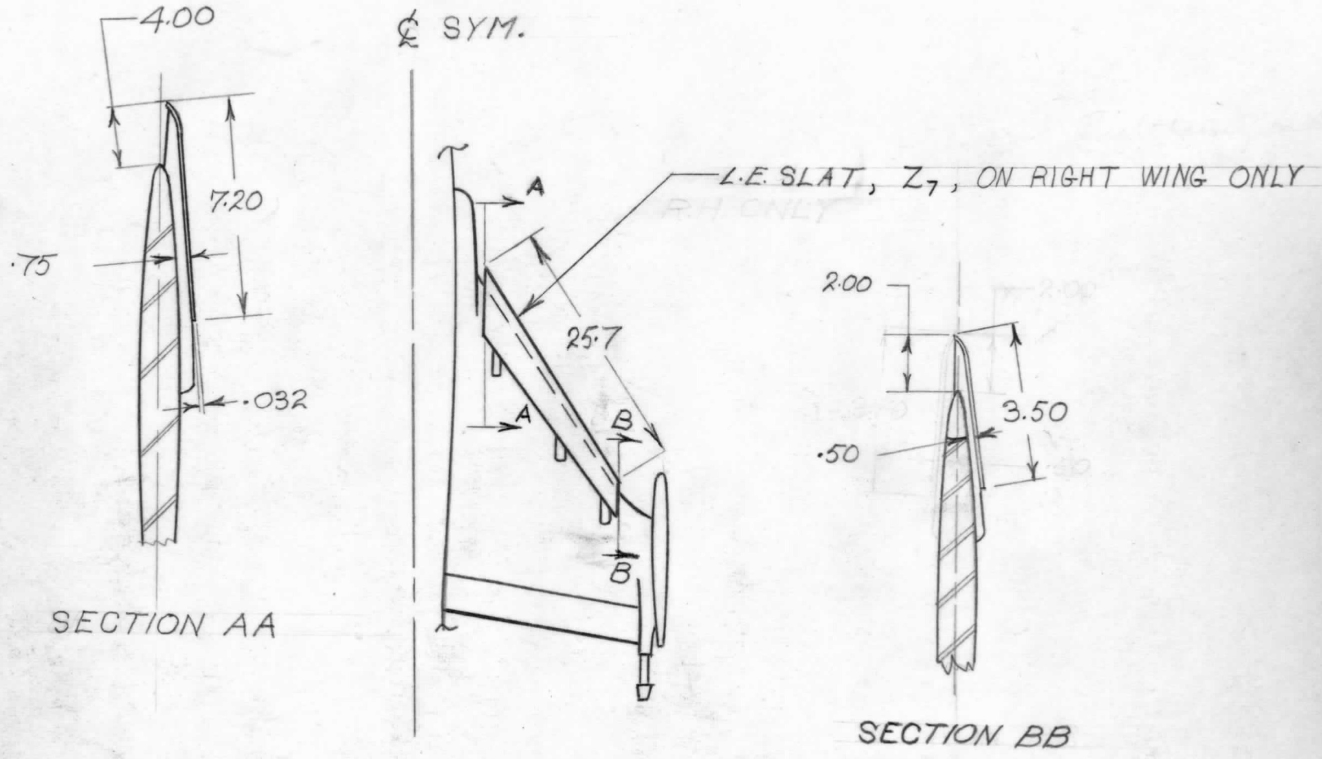

LEADING EDGE SLAT (Z_7)

.15 SCALE XFY-1

DIMENSIONS INCHES MODEL SCALE

H.H.R. 11-11-52

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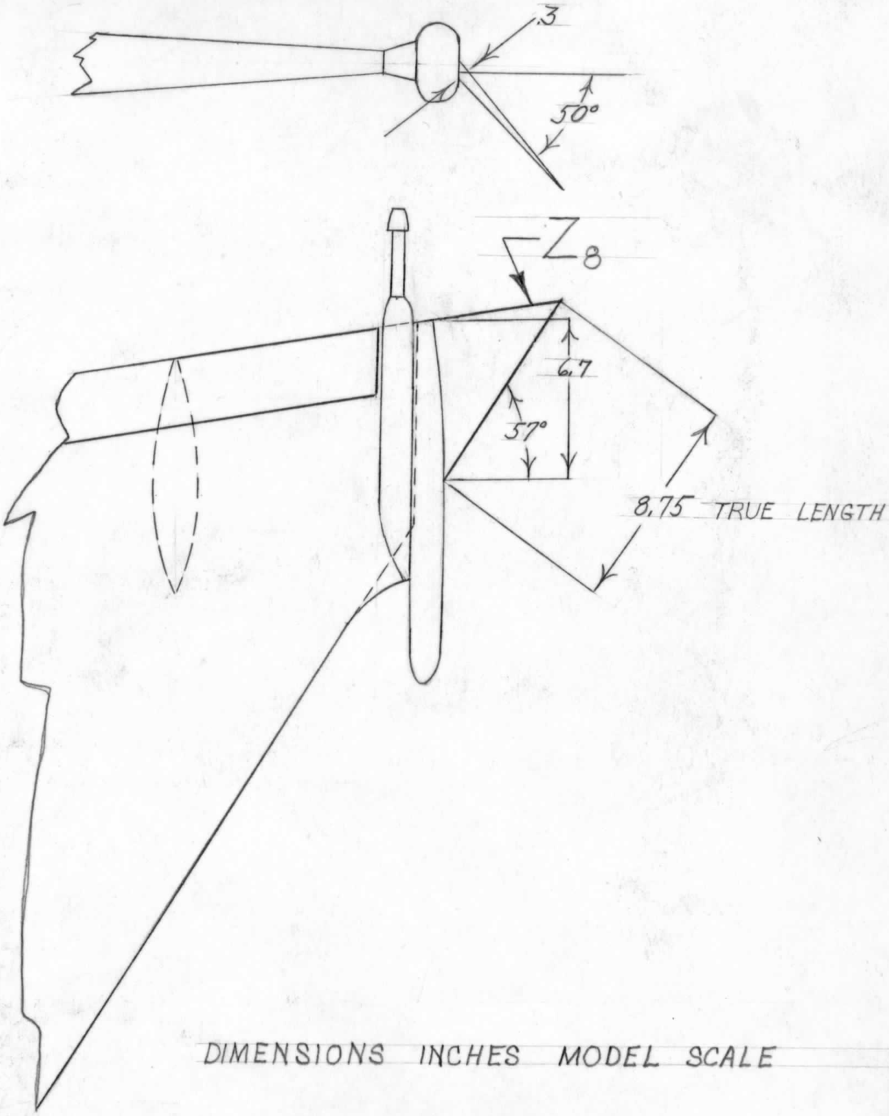

DIMENSIONS INCHES MODEL SCALE

Z_8, DROOPED TIPS

.15 SCALE XFY-1

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11-12-52-D.L.

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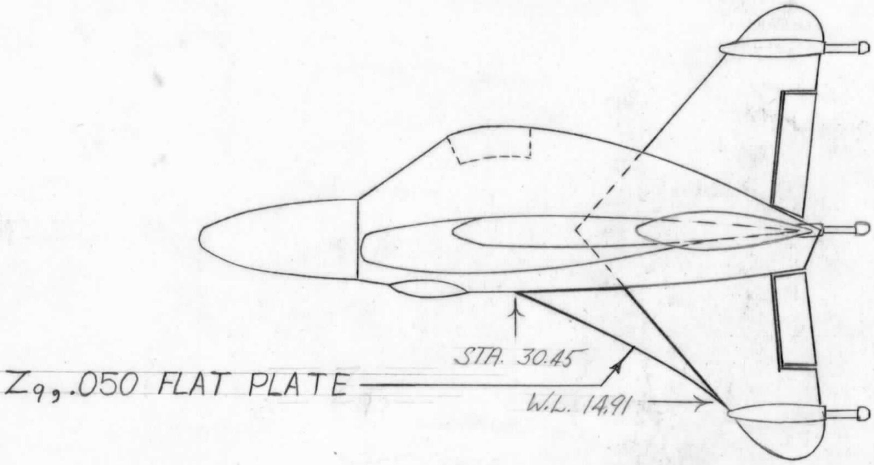

DIMENSIONS INCHES MODEL SCALE

Z_9, VENTRAL FIN

.15 SCALE XFY-1

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11-13-52- D.L.

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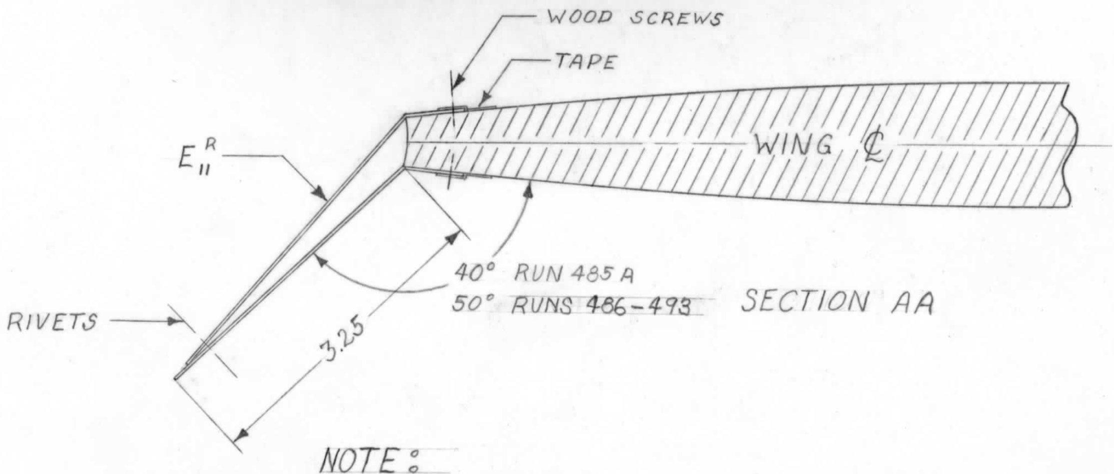
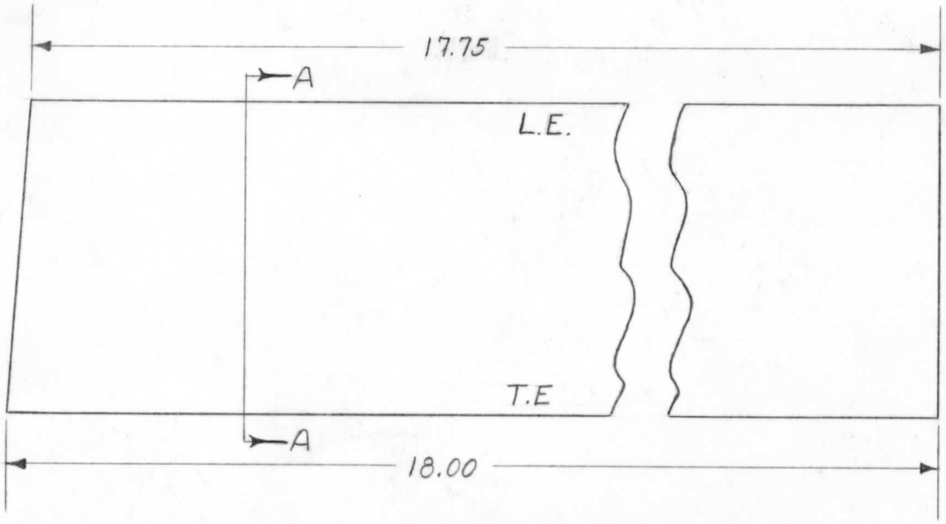


NOTE:
NORMAL RIGHT ELEVON E_3^R WAS REMOVED FROM MODEL AND REPLACED WITH SUBSTITUTE ELEVON E_{11}^R TO PERMIT RIGHT ELEVON DEFLECTION OF 50°



E_{11}^R, RIGHT ELEVON

E_{11}^R MADE TO PERMIT FIXED 50° ELEVON DEFLECTION
SAME PLANFORM AS E_3^R

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DESCRIPTION OF MODEL COMPONENTS

Symbol	Description	Page No.	CVAC Dwg. No.
S_3	Complete model $(W_3E_3B_3V_3O_3M_3F_3C)$	279,280	WT-51-5022
S_3°	Complete model, canopy open $(W_3E_3B^{\circ}{}_3V_3O_3M_3F_3C)$	281	WT-51-5022
S_5°	Complete model, canopy open, 50° tail $(W_3E_3B^{\circ}{}_3V_5O_3M_3F_3C)$	283	
W_3	Wing	282	WT-51-5018
E_3	Both elevons	282	WT-51-5018
B_3	Body, canopy closed	277	WT-51-5023 WT-51-5020
$B^{\circ}{}_3$	Body, canopy open	281	WT-51-5017
V_3	Top and bottom vertical tails, 40° swept leading edge	279	WT-51-5019 WT-51-5021
V_5	Top and bottom vertical tails, 50° swept leading edge	283	WT-51-5024
O_3	All 4 oleo struts	282	WT-51-5018
M_3	Both machine gun pods	282	WT-51-5013
F_3	Aileron actuator fairings	287	WT-51-5018
C	Oil cooler	288	WT-51-5007
P	Propellers	278	WT-51-5029
V_3^T	Top vertical tail, center position	12	WT-51-5019
V_3^{T1}	Top vertical tail in forward position	12	WT-51-5019
V_3^{T2}	Top vertical tail in aft position	12	WT-51-5019
V_3^L	Lower vertical tail, center position	12,279	WT-51-5019
O_3^B	Lower tail oleo strut	279	WT-51-5018
Tufts	Tufts On left side of vertical tails and left rear portion of body.	297	

DESCRIPTION OF MODEL COMPONENTS (Cont'd)

Symbol	Description	Page No.	CVAC Dwg. No.
E_3^L	Left Elevon	282	WT-51-5018
E_{11}^R	Special right elevon for 50° deflection	290,14h	
Y	Rudder actuator fairing	290	WT-51-5021
Z_1	Parachute on right wing tip	14a	
Z_2	Spoilers on left wing, top and bottom	14b	
Z_3	Spoiler on left wing, top only	14b	
Z_4	Dams on left wing, top and bottom	14c	
Z_5	Drag cup on right wing tip	14d	
Z_6	Drag cups on both wing tips	14d	
Z_7	Leading edge slat on right wing	14e	
Z_8	Extended droop wing tips	14f	
Z_9	Large dorsal on lower vertical tail	14g	
G_1^2	Ground board 2 feet full scale below lowest oleo	285	
G_1^4	Ground board 4 feet full scale below lowest oleo		
G_1^2 at 70°	Ground board 2 feet below lowest oleo with turntable at 70°	286	
R	Pressure rake, static and dynamic		
R_1	Pressure rake, static only		
Mouse	Pressure pick-up tube taped to model		
R_2	Pressure rake, static only	295	
R_2'	R_2 with fillet	295	
Net_1	Large mesh turbulence net, 2" squares		
Net_2	Small mesh turbulence net, 5/8" squares	277	

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NOMENCLATURE

DEFINITIONS

Y_6	yaw test measuring 6 components
P_6	pitch test measuring 6 components
CTP_6	constant thrust pitch test measuring 6 components
CTY_6	constant thrust yaw test measuring 6 components
CRP_6	constant RPM propeller calibration test in pitch
TTP_6	transition thrust pitch test measuring 6 components
Pix	tuft photographs, tufts on left side vertical tail, see photo nos. 41-61
HP_6	hovering pitch test measuring 6 components
HY_6	hovering yaw test measuring 6 components
Aero Tare	support windshield interference tare test
Press	pressure test measuring dynamic and/or static pressures around the propeller spinner
Visual	parachute test, visual observation and photographs, model rigged in pitch position

COEFFICIENTS

Stability Axis Notation (see sketch page 26)

C_L	lift coefficient, (lift/qS)
C_D	drag coefficient, (drag/qS)
C_Y	side force coefficient, (side force/qS)
C_m	pitching moment coefficient, (pitching moment/qS$\bar{c}$)
C_ℓ	rolling moment coefficient, (rolling moment/qSb)
C_n	yawing moment coefficient, (yawing moment/qSb)

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NOMENCLATURE (Cont'd)

COEFFICIENTS (Cont'd)

Body Axis Notation (see sketch page 27)

Transitional Flight Data

C_Z	normal force coefficient, positive down, (normal force/qS)
C_X	axial force coefficient, positive forward, (axial force/qS)
C_Y	side force coefficient, (side force/qS)
C_m	pitching moment coefficient, (pitching moment/$qS\bar{c}$)
C_ℓ	rolling moment coefficient, (rolling moment/qSb)
C_n	yawing moment coefficient, (yawing moment/qSb)

Hovering Flight Data

$C_Z{}'$	normal force coefficient, positive down, (normal force/$q_{S_\infty} S$)
$C_X{}'$	axial force coefficient, positive forward, (axial force/$q_{S_\infty} S$)
$C_Y{}'$	side force coefficient, (side force/$q_{S_\infty} S$)
$C_m{}'$	pitching moment coefficient, (pitching moment/$q_{S_\infty} S\bar{c}$)
$C_\ell{}'$	rolling moment coefficient, (rolling moment/$q_{S_\infty} Sb$)
$C_n{}'$	yawing moment coefficient, (yawing moment/$q_{S_\infty} Sb$)

Wind Axes Notation (see sketch page 24)

Hovering Flight Data

$C_D{}'$	drag force coefficient, (drag/$q_{S_\infty} S$)
$C_C{}'$	crosswind force coefficient, (crosswind force/$q_{S_\infty} S$)

Subscript $.14\bar{c}$ shows horizontal location of moment reference. Vertical reference shown on page 8.

$T_c{}'$	thrust coefficient, (thrust/qS)

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COEFFICIENTS (Cont'd)	NOMENCLATURE (Cont'd)
$\frac{\Delta p}{q}$	Pressure coefficient, $\frac{p_{local\ static} - p_{free\ stream\ static}}{q_{free\ stream\ dynamic}}$

SYMBOLS

α_t	for pitch tests, wind tunnel turntable angle (see sketch page 22, and figures A and B) for yaw tests, model support pitch angle, same as α_g as defined on sketch page 23
ψ_t	for yaw tests, wind tunnel turntable angle, same as ψ_g as defined on sketch page 23. For pitch tests, model support yaw angle, (see sketch on page 22, and figures A and B)
ϕ_t	model support roll angle, (see sketch page 22, and figures A and B)
θ_t	longitudinal model tilt angle for hovering, $\theta_t = \alpha_t - 90$
ψ_t'	directional model tilt angle for hovering, $\psi_t' = \psi_t - 90$
α_g	geometric angle of attack as defined in NACA TR-474: the acute angle measured in the model plane of symmetry between the longitudinal axis of the model and the line of the relative wind direction projected into the plane of symmetry. The angle is positive when the nose of the model is above the projected relative wind. (see sketch page 23, and figures A and B)
ψ_g	geometric angle of yaw as defined in NACA TR-474: the acute angle between the direction of the relative wind and the model plane of symmetry. The angle is positive when the nose of the model is turned to the right of the relative wind. (see sketch page 23, and figures A and B)
ϕ_g	geometric angle of roll as defined in NACA TR-474: the angle through which the model must be rotated about its longitudinal axis in order to bring the lateral axis into a horizontal plane. The angle is positive when the right wing is down. (see sketch page 23, and figures A and B)
α	angle of attack of the wing reference plane relative to equivalent free stream

NOMENCLATURE (Cont'd)

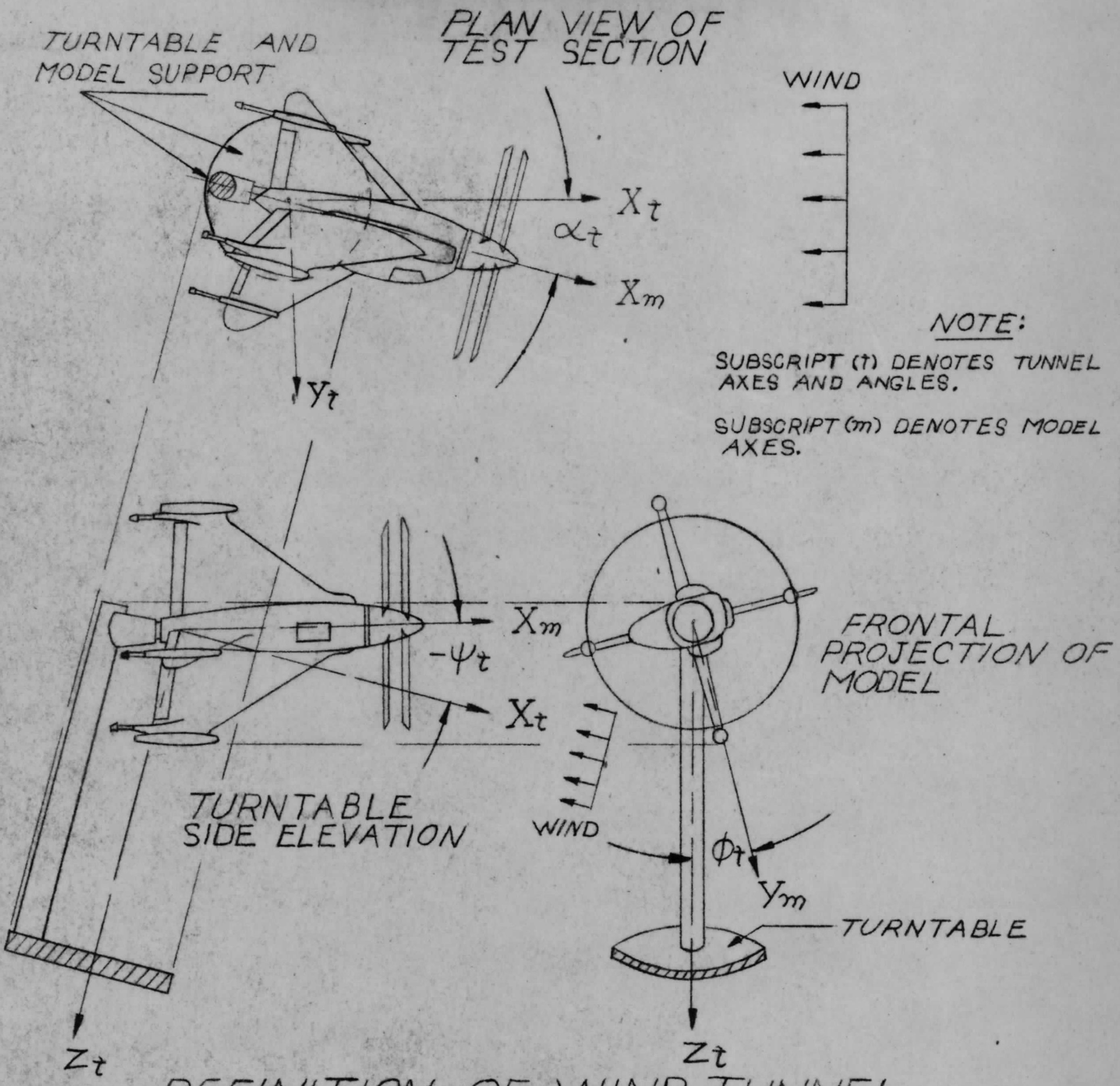
SYMBOLS (Cont'd)

δ_e	elevon angle when deflected as an elevator, referred to wing chord plane (+down, -up)
δ_r	rudder angle referred to chord plane of vertical tail (+left, -right)
δ_a	elevon angle when deflected as an aileron referred to wing chord plane (+down, -up), sign of right elevon is given above the sign of the left
δ_{a_r}	rudder angle when deflected as an aileron referred to chord plane of vertical tail (+left, -right), sign of top rudder is given above sign of bottom
q_m	uncorrected dynamic pressure, lbs/ft^2
q	dynamic pressure averaged over model span, ($1/2\rho V^2$), lbs/ft^2
V	average airstream velocity, ft/sec
ρ	mass density of air, corrected for compressibility, (slugs/cu.ft.)
q_{s_∞}	average theoretical dynamic pressure of propeller slipstream at a large distance behind propeller disc, $\left(\frac{4T}{\pi D^2}\right)$
$\frac{V_z}{V_{s_\infty}}$	crosswind velocity ratio for hovering, $\sqrt{\frac{q}{q_{s_\infty}}}$
$\frac{V_y}{V_{s_\infty}}$	crosswind velocity ratio for hovering, $\sqrt{\frac{q}{q_{s_\infty}}}$
V_z	crosswind velocity toward lower wing surface tending to increase angle of attack, $\sqrt{\frac{2q}{\rho}}$
V_y	crosswind velocity toward left side of vertical tail tending to increase angle of yaw, $\sqrt{\frac{2q}{\rho}}$

NOMENCLATURE (Cont'd)

SYMBOLS (Cont'd)

V_{s_∞}	average theoretical velocity of propeller slipstream at a large distance behind propeller disc.
T	model thrust, lbs.
Δp	increment in static pressure between the position noted and free stream static pressure, lbs/ft^2
D	model propeller diameter, ft (2.40 ft)
β	propeller blade angle at .75 radius, degrees, ($\beta = 25°$ indicates same pitch both props, $\beta = \begin{matrix} 12.65^\circ F \\ 14.00^\circ R \end{matrix}$ indicates front prop pitch of 12.65° and rear prop pitch of 14.00°.)
$\bar{c}$	model mean aerodynamic chord, ft. (2.357 ft)
b	model wing span, ft. (3.850 ft)
S	model wing area, sq. ft. (7.988 ft^2)



NOTE:

SUBSCRIPT (t) DENOTES TUNNEL AXES AND ANGLES.

SUBSCRIPT (m) DENOTES MODEL AXES.

DEFINITION OF WIND TUNNEL REFERENCE ANGLES (α_t, ψ_t, ϕ_t) FOR PITCH TESTS

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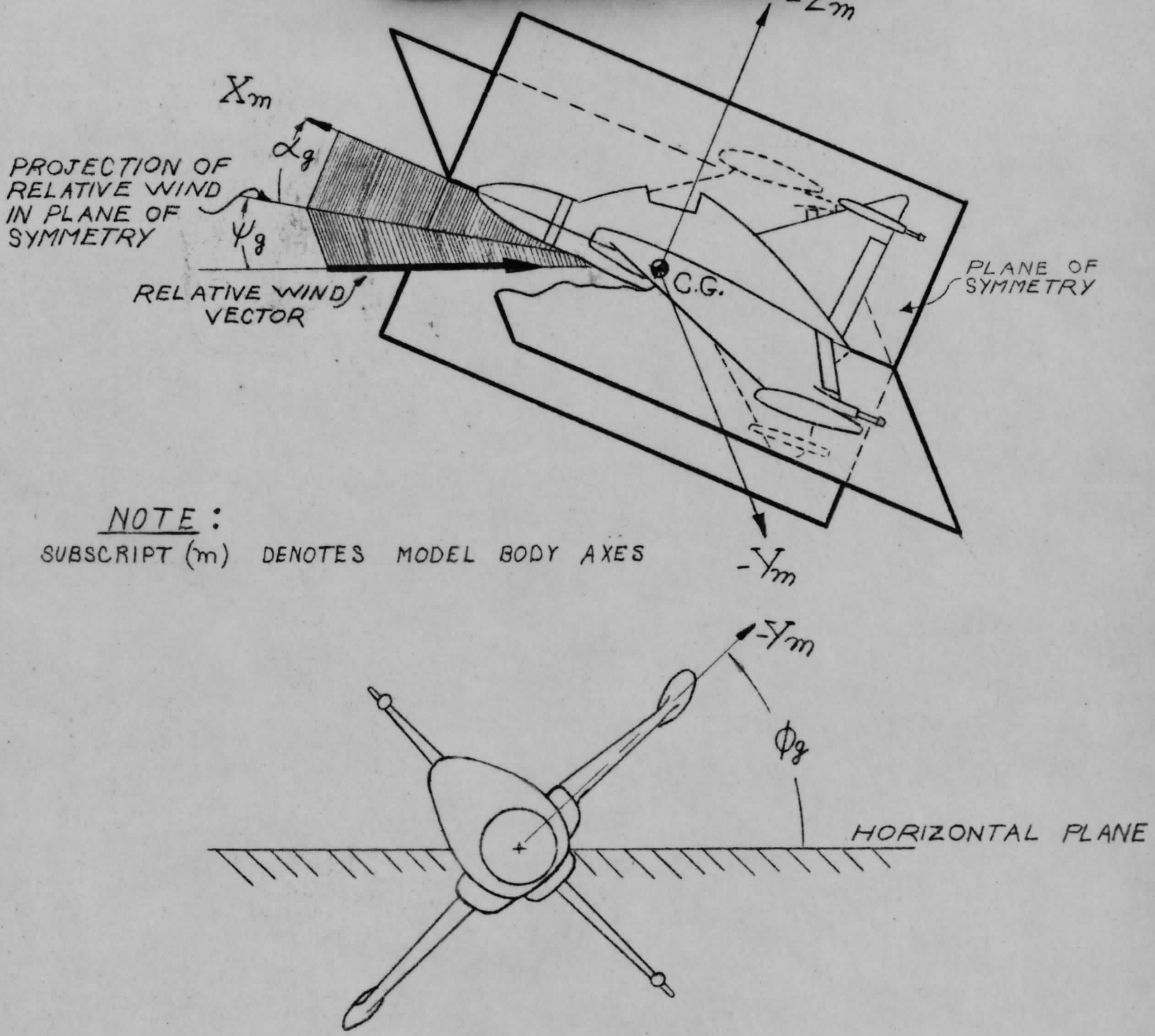

NOTE: SUBSCRIPT (m) DENOTES MODEL BODY AXES

*DEFINITIONS OF GEOMETRIC REFERENCE ANGLES (α_g, ψ_g, ϕ_g)

*AS DEFINED IN NACA TR-474

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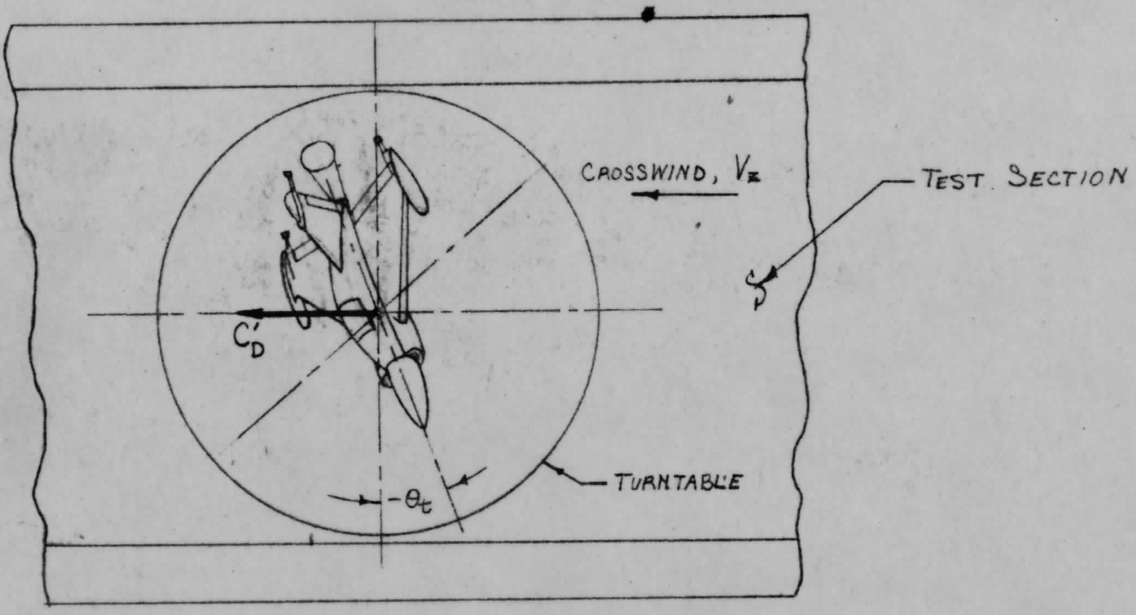
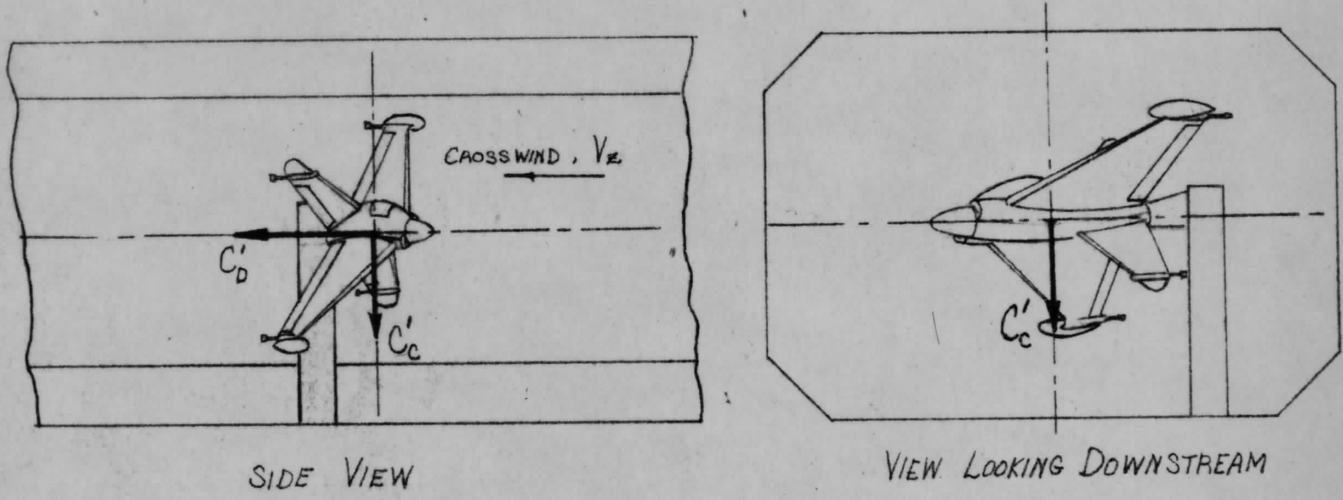


PLAN VIEW



SIDE VIEW

VIEW LOOKING DOWNSTREAM

DEFINITION OF LONGITUDINAL TILT ANGLE, CROSSWIND, AND WIND AXES FOR HOVERING TESTS IN PITCH, HP_6 TYPE TEST, $\psi_t = 0°$

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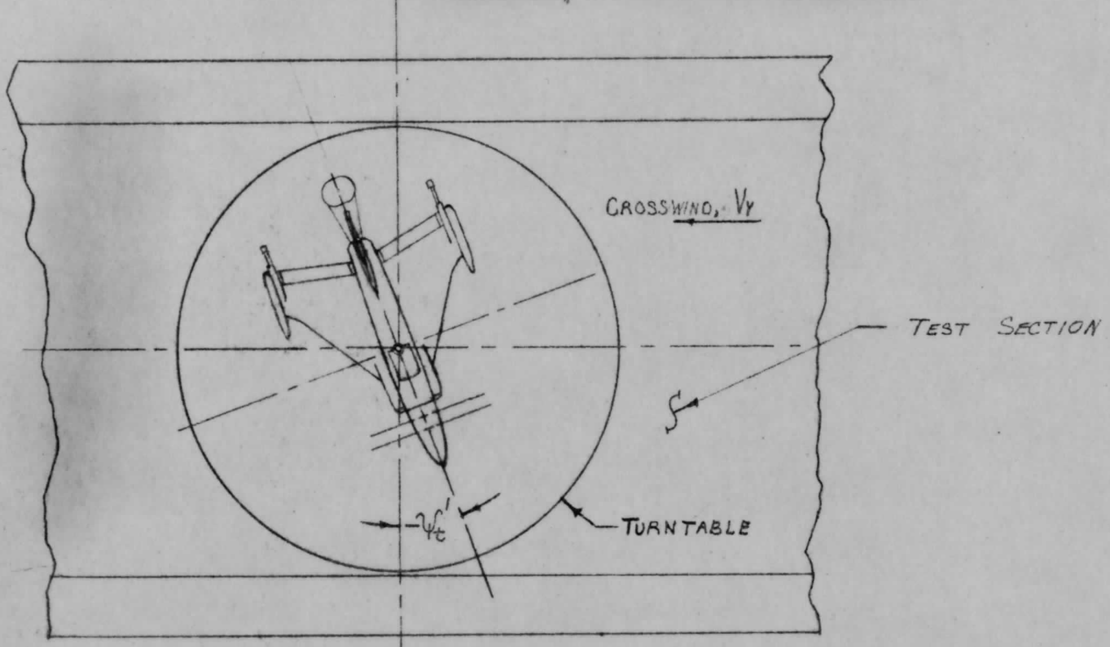
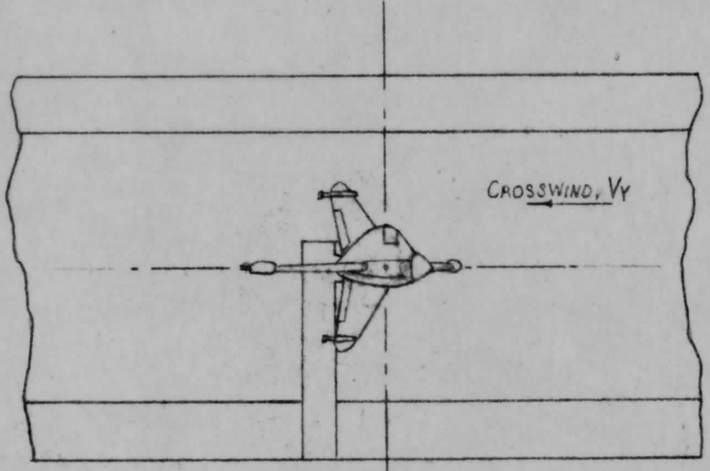
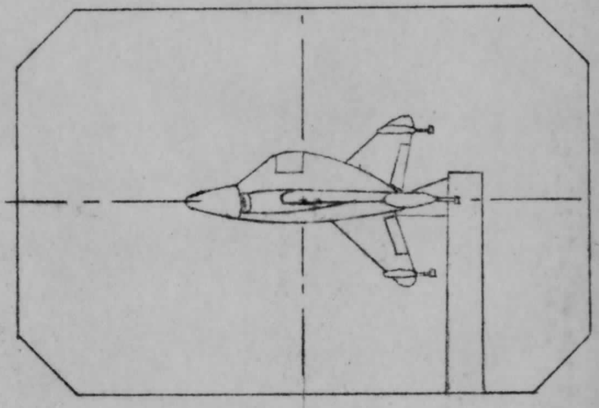


PLAN VIEW



SIDE VIEW



VIEW LOOKING DOWNSTREAM

DEFINITION OF DIRECTIONAL TILT ANGLE AND CROSSWIND FOR HOVERING TESTS IN YAW, HY_6 TYPE TEST, $\alpha_t = 0^\circ$, $\phi_t = 0^\circ$

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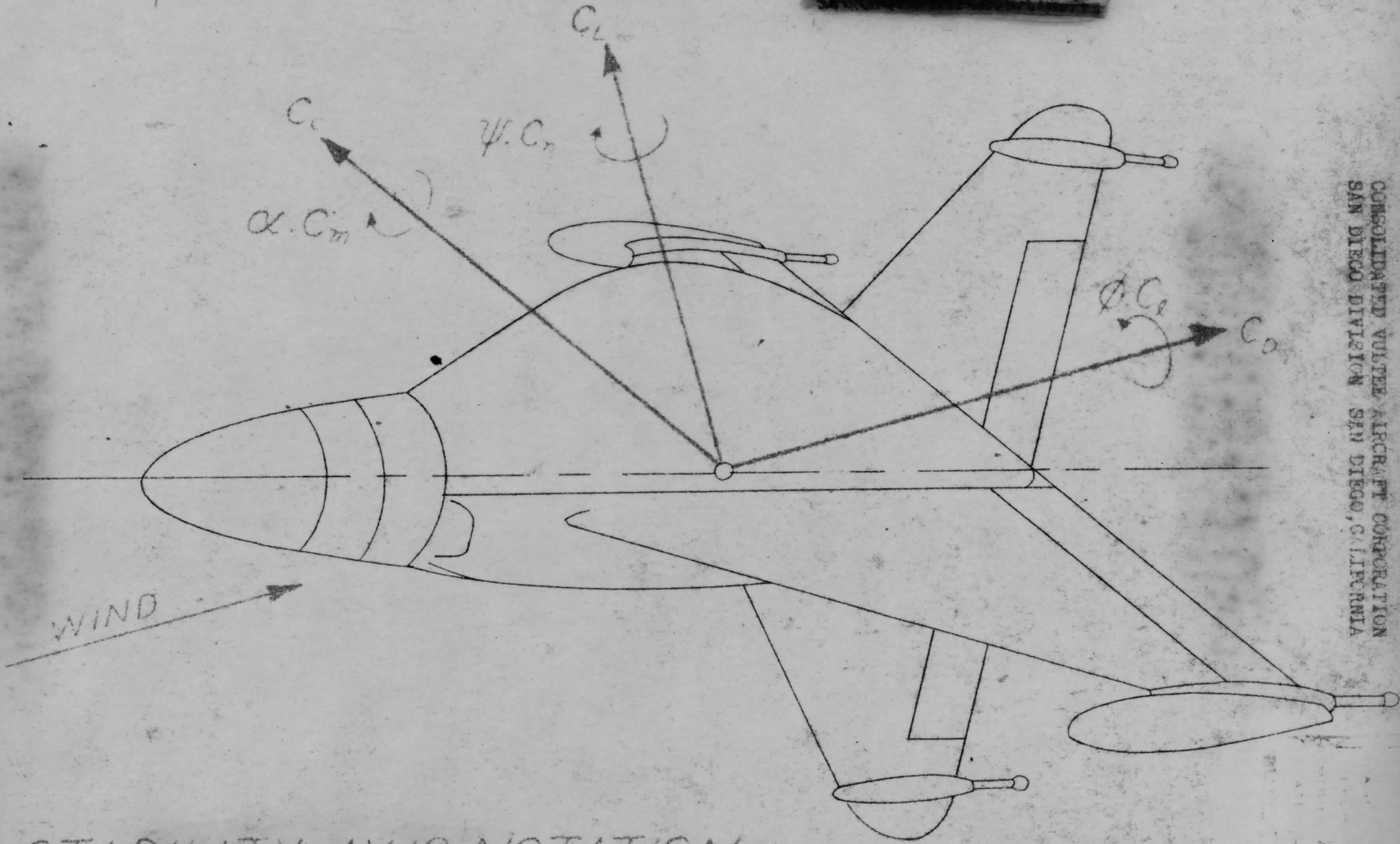

STABILITY AXIS NOTATION

POSITIVE DIRECTION OF FORCES
MOMENTS, AND ANGLES ARE SHOWN

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CONSOLIDATED VULTEE AIRCRAFT CORPORATION
SAN DIEGO DIVISION SAN DIEGO, CALIFORNIA

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MODEL
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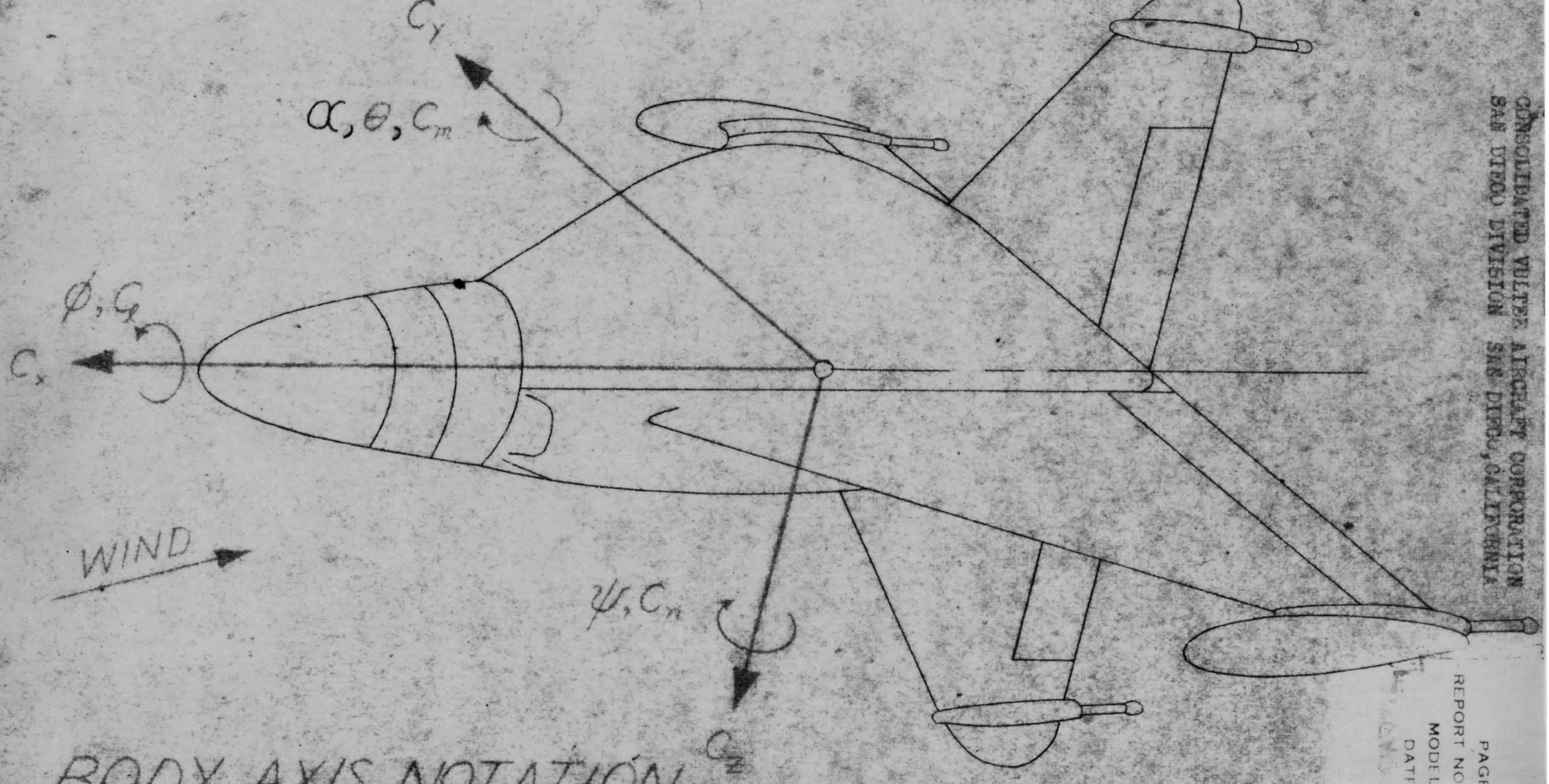

BODY AXIS NOTATION

[redacted]

POSITIVE DIRECTION OF FORCES,
MOMENTS AND ANGLES ARE SHOWN